NUCLEAR ENERGY RESEARCH INITIATIVE

Optimization of Heat Exchangers

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Program Area: NHI

Collaborators: None

Project Description

The objective this research is to develop tools to design and optimize heat exchangers (HE) and compact heat exchangers (CHE) for intermediate loop heat transport systems found in the very high temperature reactor (VHTR) and other Generation IV designs by addressing heat transfer surface augmentation and conjugate modeling.

This research will be performed in two parts. Researchers will search for augmented heat transfer surface morphologies using a combination of experiment and modeling. For a particular type of surface augmentation, they will conduct experiments to obtain closure of the model and then apply it to optimize the surface. A final experiment will confirm the findings of the model. These surfaces will become candidates for the next part of the research, where they will be used in a heat exchanger. The objective is to develop and demonstrate a model that can be used to optimize heat exchangers. The model equations are available but have not been used for a two-fluid-stream heat exchanger, nor has closure been fully developed. Researchers will design and optimize a printed circuit heat exchanger (PCHE) for either a high-temperature Brayton cycle in support of the VHTR or for the reactor-hydrogen production process interface. The results of this research will be a validated computer program for the design of heat exchangers that maximize heat transfer and minimize pumping power.

Workscope

The major technical objectives of the proposed research are to:

1) Develop a surface that increases surface heat removal effectiveness by a factor of four without a marked increase in pumping power
2) Develop a new type of mathematical model capable of predicting flow and heat transfer in 2D and 3D spatial structures at different scales
3) Design and carry out experiments to measure heat transfer augmentation and validate the HE and CHE models used for optimization
4) Design and test a printed circuit heat exchanger for a high-temperature inert gas cycle.